EDITORIAL ARTICLES.

THE AMBULANT TREATMENT OF FRACTURES OF THE LOWER EXTREMITY.

I. J. P. WARBASSE: "The Ambulant Treatment of Fractures of the Tibia and Fibula."—*Transactions of the Brooklyn Surgical Society*, October, 1894; *Brooklyn Medical Journal*, 1895.

II. A. VON BARDELEBEN: "Über die frühzeitige Bewegung gebrochener Glieder, mit besonderer Rücksicht auf die untere Extremitat."—*Verhandlungen der deutschen Gesellschaft für Chirurgie*, XXIII Kongress, 1894.

III. KORSCH: "Demonstration von Fällen, die wegen Ober- und Unterschenkelbrüchen und komplicirten Bruchen seiner Zeit mit ambulatorischen Gipsverbänden behandelt worden sind."—*Verhandlungen der deutschen Gesellschaft für Chirurgie*, XXIII Kongress, 1894.

IV. ALBERS: "Über Gehverbände bei Brüchen der unteren Gliedmassen."—*Verhandlungen der deutschen Gesellschaft für Chirurgie*, XXIII Kongress, 1894.

V. KRAUSE: "Albers, Über Gehverbände bei Brüchen der unteren Gliedmassen."—*Verhandlungen der deutschen Gesellschaft für Chirurgie*, XXIII Kongress, 1894.

I. WARBASSE extols the plaster bandage in the treatment of fractures of the extremities. The use of the box, the inclined plane, and the many mechanical contrivances employed in the treatment of fractures of the leg may be said to have become almost entirely superseded by the plaster bandage, at least in the hands of those who have to treat any considerable number of fractures. Though no dogmatic statement should be made to the effect that plaster is indicated in all such fractures, for conditions may exist which call for one of the other modes of treatment; still it may be stated that the plaster bandage is applicable to by far the greater number of such injuries, and this number may be said to include not only the simple fractures, but also those of a compound and complicated character. Untoward results occur only in the hands of those unskilled in its use. With the introduction of the plaster bandage into surgical practice there came to the patient with a broken leg the priceless boon of being able to be up and about on crutches, instead of sitting or lying through the weary period of a month or more anchored to some mechanical contrivance, and in this very feature lies one of the great advantages of the plaster dressing.

The purpose of this paper is to deal with certain modifications of the plaster splint, by means of which the patient who has sustained a fracture of the leg may not only be up and about, but may be enabled to walk unaided on both legs without pain, and without interfering with the consolidation of the broken bones.

F. Krause published a paper in 1891 upon the treatment of fractures of the bones of the leg in walking patients.[1] Some two years later Korsch appeared with a paper upon the same subject, including also fractures of the thigh and compound fractures.[2] An objection to his method was that he applied a plaster bandage immediately in contact with the skin. Notwithstanding the very great care employed decubitus occurred in two of his cases. The bandage was made to extend part way up the thigh, fixing the leg in a position of slight flexion. At about this same time Bruns, of Tübingen, published his article on the ambulant treatment of fractures of the leg and thigh, his invention consisting of a splint made of metallic rods and leather straps, by means of which the whole leg was suspended, the weight of the body being borne largely by the tuber ischii and perineum.

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[1] F. Krause: Beiträge zur Behandlung der Knochenbrüche der unteren Gliedmassen in Umhergehen,—Deutsche medicinische Wochenschrift, 1891, No. 13.

[2] Korsch: Über den ambulatorischen Verband bei Knochenbrüchen des Unter- und Oberschenkels, so wie bei komplicirten Brüchen,—Berliner klinische Wochenschrift, 1893, No. 2.

In cases of fracture of the tibia or fibula, the thigh muscles as well as the leg muscles suffered from the atrophy of disease,—a condition which is not brought about when the simple plaster cast is used.[1]

In the latter part of the year 1893, Dollinger, of Budapesth, appeared with a description of a removable splint for the ambulant treatment of fractures of the bones of the leg, reporting three cases upon which he had employed his method.[2]

The idea of the method employed by Warbasse was obtained, he states, from Dollinger's paper. He has practised it, since the latter part of the year 1893, upon six cases in the service of Dr. L. S. Pilcher in the Methodist Episcopal Hospital in Brooklyn. The method, as he practises it, consists, first, in the reduction of the fracture, and cleansing of the skin of the leg with soap and water. Then with the foot fixed at a right angle to the leg, a flannel bandage is smoothly and evenly applied from the toes to just above the knee. This bandage is made to include beneath the sole of the foot a padding of ten or fifteen layers of cotton wadding, making a pad about three-fourths of an inch thick, when it is compressed by the moderate pressure of the flannel bandage. Over this is now applied the plaster bandage from the base of the toes to just above the knee, especial care being taken that the application is made smoothly and somewhat more firmly than is the custom in the ordinary plaster cast. The layers of the bandage should be well rubbed as it is applied, with the view of obtaining the greatest amount of firmness with the smallest amount of material. The sole is strengthened by incorporating in with the circular turns an extra thickness composed of ten or twelve layers of bandage well rubbed in together, and extending longitudinally along the sole. The bandage is applied especially firmly about the enlarged upper end of the tibia, and here it is made somewhat thicker. As it dries it may be pressed in so as to conform more closely to the leg just below the heads of the tibia and fibula. The assistant, who stands at the foot of the table and supports the leg, makes such traction or pressure as is required to keep the fragments in proper position, while the plaster is being applied. The operation requires about twenty minutes, and by the time the last bandage is applied the cast should be fairly hard.

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[1] P. Bruns: Über den Gehverband bei Fracturen und Operationen an den unteren Extremitäten, nebst Beschreibung einer neuen Geh- und Lagerungsschiene,—Beiträge zur klinische Chirurgie, x Band, 2 Heft, 1893.

[2] Dollinger: Eine einfacher abnehmbarer Gipsverband zur ambulanten Behandlung der Unterschenkelfracturen,—Centralblatt für Chirurgie, No. 46, 1893.

It is seen that when this cast has become hardened the leg is suspended. When the patient steps upon the sole of the plaster cast, the thickness of the cotton beneath the foot separates the sole of the foot so far from the sole of the cast that the foot hangs suspended in its plaster shoe. Thus the weight of the body which would come upon the foot is borne by the diverging surfaces of the leg above the ankle. The chief of these is the strong head of the tibia. A lesser rôle is played by the head of the fibula, and the tapering calf in muscular subjects.

The immediate application of such a splint prevents subsequent swelling, because the swelling which follows a fracture is largely due to the movements of the ends of the fragments; and the sooner the thorough immobilization is effected, the less will be the swelling. Examples of this fact are seen in the fractures of the skull and pelvis.

The bandage in one case was not carried beyond the head of the tibia, thus allowing the use of the knee. The upper end of the cast seemed to interfere with the flexion of the joint. It is the opinion of the author that such a dressing can be applied and allow of a perfect freedom of the joint, and he intends in the future to employ the shorter cast in cases of fracture below the middle third of the leg. The use of a snug-fitting long stocking is also suggested in the place of the flannel bandage.

The cases reported are briefly as follow:

Case I.— Housewife, aged twenty-six. Fracture of fibula just above malleolus. Cast was applied on the day following the accident, but was not extended above the knee. On the following day she was able to walk about the ward. This case was not followed up to its termination.

CASE II.—Driver, aged twenty-one. Fracture of tibia in middle of middle third. Cast was applied on the day following the injury. On the following day the patient walked about with comfort, and was discharged from the hospital. He returned weekly for observation, walking with a cane. At the end of six weeks the splint was removed, and firm consolidation was found.

CASE III.—Butcher boy, aged fourteen. Fracture of fibula just above malleolus. The cast was applied on the day following the accident. On the next day the patient was able to walk with perfect comfort, and two days later he was discharged. During the following five weeks he walked to the hospital for repeated observations, and at the end of that time the cast was removed, and firm union found to have taken place.

CASE IV.—Teamster, aged twenty-nine. Fracture of fibula two inches above its lower extremity, and fracture of the tip of the malleolus of the tibia. There was considerable swelling about the ankle, and an abrasion of the skin on the inner side of the leg. Seven days after the injury the swelling had quite subsided, though the abrasion was not entirely healed. At that time a walking cast was applied. On account of the swelling the patient was not able to walk very well, though he could bear his weight on the injured limb. He was discharged on the following day, and has secured a good result.

CASE V.—Peddler, aged eighteen. Fracture of both tibia and fibula a little above the middle of the leg. Two days after the injury the walking cast was applied. On the following day he walked about the ward almost as though the leg were sound. It was such a pleasure to see a patient with a fracture of the upper part of both bones of the leg walking about unaided on the third day after the accident that he was retained in the hospital four days longer. After his discharge he returned for subsequent observations till the cast was removed at the end of the sixth week. The result was so perfect that four months after the injury there was scarcely any sign of the previous existence of a fracture.

CASE VI.—Laborer, aged twenty-four. Fracture of fibula two inches above malleolus. The cast was applied on the third day after the accident. This patient was able to walk satisfactorily. He returned for subsequent observations, and on the fifth week the cast was removed and good union found, though some slight swelling persisted about the seat of the fracture for several weeks.

The results in these cases were as invariably good as those which had been put up in the simple plaster cast; and, certainly, if for any reason the patients did not care to walk, they could lie about as though they had on the ordinary cast. It is the author's opinion that by a little experience one can practise this method of treatment with great success and with eminent satisfaction to the patient. In the case of business men or those whose occupations do not put much strain upon the legs, a fracture of the leg need not ordinarily cost a man more than two days' detention from business.

Aside from the purely business aspect of the question, Bardeleben has called attention to the fact that with the walking cast the dangers of decubitus are lessened, the muscles do not atrophy, and consolidation takes place more quickly than when continuous quiet is enforced. The general condition, the appetite, digestion, and sleep are more natural than when the patient is kept quiet. This is of especial importance in old people in whom the dangers of hypostatic pneumonia are so great. The drinking man stands a much better chance of escaping delirium tremens if he can take daily exercise. This complication occurs so commonly in cases of fracture treated by the old method that Bardeleben does not regard it as a mere matter of chance that not a single case of delirium has developed among the large number of drinking men treated with the "walking cast" at his clinic.

Dollinger renders such a cast removable by strengthening the posterior segment by means of six or eight extra thicknesses of narrow bandage placed longitudinally and included in the grasp of the circular turns. As soon as the bandage has become hard, but is still damp, this posterior segment is cut out by two longitudinal cuts down the postero-lateral aspect of the leg. Four leather straps with buckles are applied around the leg to hold the two parts of the cast together. This allows of the removal of the cast for the purpose of massage or the treatment of compound fracture.

Albers has made a much lighter splint by using only an under-dressing of plaster and covering this with strips of wood, shavings, and crinoline held together with glue.

The author expresses his belief in the entire feasibility and great value of the gehverband as a conclusion of his experience with its use.

II. BARDELEBEN has treated 8000 fractures during the past 50 years, 4058 of these have occurred during the last 17 years, and are recorded in the annals of the Charité. During the past two years 116 fractures of the lower extremities have been treated in walking splints. Of these 89 were fractures of the leg (12 complicated), 5 were fractures of the patella, and 22 were fractures of the thigh, of which 5 were compound. These include three cases of osteotomy for genu valgum.

The advantages of the early mobilization of fractured limbs, especially the walking about with broken legs, have hitherto been taken advantage of but little. Bardeleben recalls how that over thirty years ago he sustained a fracture of the malleolus and dislocation of the foot, and walked about on the first day, and never allowed the accident to confine him for any length of time. The advantages of such early motion are self-evident, especially from the stand-point of the patient. The patients themselves have to appreciate the advantages of this new method. None had to have the "gehverband" applied against his will.

In regard to the dangers of the walking splint Bardeleben does not regard the method as a "lazy makeshift," as Stromeyer has called the plaster cast. It requires careful watching. It is safer to wait till the third or fourth day before applying the cast. If the swelling is considerable when the cast is applied it will usually be necessary to remove it in a few days, not because of any increase in the swelling, but because under the quiet which the splint has insured the swelling has become so diminished that the cast is entirely too large. It is desirable during the whole period of treatment, at least with plaster splints, that the dressing should fit exactly to the limb. This is, of course, especially necessary where extension is desired, as in fractures of the upper end of the femur. Here it is important that about all of the bony prominences the bandage shall fit snugly. During the entire period of treatment the surgeon has, on one hand, the complaint of the patient as to local pressure and, on the other, the appearance of the toes to keep him informed of the condition of the limb ; though he had better cut off the bandage ten times too often than once too seldom.

The treatment of open fractures by the "gehverband" requires especial caution. It is well known that the compound fractures, not only from olden times, have been regarded as the test of surgical capability, but also since the introduction of the antiseptic method they have had a high claim upon the care and skill of the physician. Certainly, by the use of the walking splint the care for the aseptic condition of the wound cannot be for a moment relaxed. When these precautions are taken there is no especial danger in the ambulant treatment of compound fractures. Bardeleben's experience involves sixteen cases, including three osteotomies of the femur. Twelve of the cases were compound fractures of the leg. Of course, there are open fractures in which amputation would be sooner thought of than the walking splint. But the majority are such that, when the first few days have demonstrated that wound infection is not going to occur, the "gehverband" can be applied.

Bardeleben lays down the following law : It is of the greatest advantage to the patients that such a dressing can be applied to a broken leg that he can bear the weight of the body upon it and walk about ; but such a method of treatment should be applied only under medical supervision and with the most careful consideration of complications which might arise.

III. Korsch preceded his demonstration of cases before the Surgical Congress with an historic sketch of the development of the walking cast. The originator of the idea was Seutin, though his dressing did not permit the patient to walk upon the broken leg.

Hessing was the first really to accomplish this practical application of a dressing in which the patient could stand upon the broken leg. His apparatus was, however, very expensive. F. Krause modified Hessing's principle in such a way that plaster of Paris could be used in fractures of the leg and in transverse fractures of the lower third of the thigh. Harbordt and Hentzner contrived apparatus for fractures of the thigh, in which extension was accomplished by an arrangement for drawing the foot down against a foot-board. Contra-extension was accomplished by a pad resting against the tuber ischii.

The author shows that passive extension, which is effected by the application of the plaster directly next to the skin of the malleoli, the dorsum pedis, and the heel, will suffice for the extension in a thigh fracture when it has firmly attached to it a semicircular seat-ring which presses against the tuber and thus accomplishes contra-extension. He first employed splints after the character of the splint of Taylor, and enveloped them in a plaster casing, leaving the knee-joint and ankle free. This was followed by the method consisting in applying a plaster cast as far up as the tuber ischii and incorporating into the same a Thomas splint made of heavy wire, the portion which pressed against the tuber being bolstered with cotton and bandage. Albers dispensed with the metallic splint, and depended upon the plaster for contra-extension. Bruns, H. Schmid, Aust, Dollinger, and Liermann have worked in the same direction.

Korsch presented but seven of his cases. Of these, three involved the thigh and four the leg. Good results were obtained in all cases.

IV. ALBERS has adopted the treatment of fractures of the leg by means of the "gehverband," which Korsch has been carrying on in Bardeleben's clinic. The splint is made with plaster bandages and a leather strip. Rarely were metallic strips and adhesive plaster employed. The plaster bandages have as a basis strips of mull without a selvage edge four to six metres long and twelve centimetres wide. These are spread out on a board, and a mass of finely-powdered modelling plaster rubbed over them. The bandages are then loosely rolled up. Before using they are plunged into hot water. They should harden in ten minutes. The leather strip, which is one metre long, one and a half centimetres broad, and two millimetres thick, is passed through hot water and laid between the outer layers of the plaster. Such a strip is inserted in front, behind, and at either side of the limb. The posterior strip passes over the heel and is continued under the foot; the anterior strip is continued down over the dorsum pedis, and the lateral ones are continued around over the others. The plaster bandage is applied directly upon the skin, which should be slightly oiled. In the application of the plaster bandage no reverses should be made, but when the direction of the bandage would be changed it should be cut, so that it shall lie perfectly smoothly. Each layer should be well rubbed. The dressing should be applied in bed. When a pelvic support is necessary the proper elevation can be secured by the use of pillows. An anæsthetization is more harmful than useful, for under narcosis the limb has a different configuration. When the muscular relaxation disappears after the narcosis, the pressure will be increased. When great pain is present it is best to employ injections of morphine. The toes should be left exposed for the observation of the circulation. Elevation of the limb will often reduce swelling; when this does not suffice, the bandage must be removed. Severe local pain from pressure indicates the cutting of a fenestrum, which should be tamponned and again covered with plaster. The first attempt at walking should be made on the day following the application of the cast. A crutch and a cane are used at first; later two canes are employed; and, finally, some patients walk without any support at all. Albers has observed seventy cases, to which may be added one case withdrawn from treatment, and seven additional cases. These seventy-eight cases were divided as follows:

Fifty-six fractures in the leg.

Five fractures of the patella (subcutaneous, transverse).

Sixteen fractures of the thigh.

One fracture of both leg and thigh.

In the fractures of the leg, the method of Korsch was employed with the modification that the application was done in two stages. The foot is fixed at a right angle and the knee extended. The slightest equino-position makes walking difficult. One assistant holds the thigh, another the foot. This second assistant also maintains the reduction of the fragments by traction, rotation, or whatever is required. By means of the two stages, the solution of the problem is made easier. First a plaster cast of five or six layers is applied. The assistant holding the foot need not be especially particular during its application. Five or six minutes after its application it is still so soft that any necessary corrections can be made. The operator now takes hold and directs and supplements the force applied by the assistant till the desired position is obtained. By traction and pressure the bandage is held in this position till hard, and thereby any recurrence of imperfect position is prevented. The bandage is then completed by the application of five or six more layers of plaster with the longitudinal strips, or with water-glass bandage. Very serviceable are wood shavings, cambric, and flannel bandages with joiner's glue. Before the latter can be applied the plaster must be thoroughly dried, —for at least twenty-four hours. The plaster is then painted over with the glue, and then a cambric bandage put on. This is then painted with glue, and the long wood shavings applied longitudinally, and held in place by another cambric bandage. This is again painted, and a flannel bandage put on over all and glued. The application of this glue dressing takes about fifteen minutes. It becomes dry in twelve hours, so that the patient can walk on it. The plaster and glue splint is very light and strong. It can be cut down so as to form a removable antero-posterior splint, and still give the necessary support.

Out of the fifty-six fractures of the leg thus treated were,—

Twenty-one malleolar fractures (both malleoli in fourteen cases).

Eight fractures in the lower third (both bones in seven cases; one open fracture).

Fourteen fractures at the junction of the lower and middle thirds (in seven cases the line of fracture in the tibia was very oblique; one open fracture).

Thirteen fractures of the middle and upper thirds (in six cases the line of fracture in the tibia was very oblique; two open fractures).

When the swelling was not great the splint was put on on the first or second day; but if the swelling persisted the leg was left on a Watson's splint for a day or two, and then if it did not disappear the cast was applied as usual.

In open fractures the soft parts, when possible, were sutured in layers, or the wound was packed with iodoform gauze. The open fractures were not put up till the end of the first week. Where delirium tremens has threatened, the splint has been applied on the fifth day, and thereby an attack averted.

In malleolar fractures and breaks of the lower third, a bandage extending from the heads of the metatarsal bones to the condyles of the tibia suffices; in fractures of the junction of the lower and middle thirds, with a tendency to dislocation, the knee-joint had better be included; and in fractures higher up, the cast should reach as far as the middle of the thigh.

The malleolar cases walked in the course of the first week usually without any support. So with the fractures in the lower third of the leg. The rest used canes or cane and crutch until the last week before the consolidation. These fifty-six patients were all able to walk eventually without trouble.

Consolidation in the malleolar fractures took place on an average in three weeks; and in the fractures at the middle and lower thirds in from five to six weeks. In the remainder of cases consolidation took place in from three to fourteen weeks,—averaging eight weeks. In the treatment two or three casts were necessary. Considerable decubitus did not occur in any of the cases. A bandage applied too soon had once to be removed. When the casts were taken off the ankle and knee-joints were found movable; and in no case was there any considerable muscular atrophy.

Patients with malleolar fractures and fractures of the lower third were, on an average, able to return to work in six weeks; those with fractures in the lower border of the middle third in nine weeks; and those with higher fractures after the thirteenth week.

In cases of fracture of the patella a plaster bandage is applied from the malleoli to within three inches of the tuber ischii. This cast has a big fenestrum over the knee, through which the patella appears. For the protection of the fracture a strip of iron band, running three or four centimetres in front of the knee, is incorporated in the plaster above and below. The fragments of the patella are drawn together with adhesive plaster. When there is not much fluid in the joint, the dressing is applied immediately. Otherwise, the fluid is drawn off by aspiration, and the limb treated on the Watson splint for a week. Five patients were thus treated by Albers, the separation representing one and a half to three and a half centimetres. From three to seven weeks were required in obtaining a firm union. All of the patients walked with this splint, and after its removal without support; and after a few weeks were able to bend the knee ninety degrees. The confinement in the hospital averaged fifty-two days.

Osteotomies after Ogston for genu valgum were treated on the day after the operation by the application of a plaster cast reaching from the malleoli to within three inches of the tuber ischii, with which the patient (two cases) was allowed to stand on the third day after the operation. Later this was replaced with a plaster and glue capsule, which was removed daily after the sixth week for massage and passive motion, and then replaced for walking.

The "walking splint" for fracture of the thigh reaches from the heads of the metatarsal bones to the tuber ischii, and is applied in four stages,—

(1) Plaster bandage from the metatarsal bones to the knee,

directly upon the skin; five to six thicknesses; foot at a right angle (ten minutes' pause).

(2) Placing the patient with pelvis elevated, extension to the plaster cast which is now hard applied by assistants; contra-extension by bracing the well foot against the foot-board of the bed, and by a second assistant, who stands at the head of the bed and places his hands against the sides of the chest. The extension should be applied till the deformity is corrected and the legs of even length.

(3) Application of a plaster bandage cataplasm, eighty centimetres long, twenty centimetres broad, and eight layers thick. The upper end, which is doubled over, rests against the tuber ischii, the middle portion lies horizontally about the femur, and the lateral wing is turned upward about the gluteal folds and forward in the region of the anterior superior spine, covering the end of the middle portion, and ascending diagonally to the umbilical region, where it is held by the hand of an assistant.

(4) Uniting the first applied plaster cast and the cataplasm by four plaster bandages, in the upper layers of which four leather strips are incorporated. These bandages must thoroughly include the lower original cast.

The bandaged limb is now placed on pillows. The first attempt at walking is made on the following day.

The application consumes about thirty minutes, and the whole splint weighs about two kilogrammes.

Up to the present time fifteen patients have been treated by this means by Albers. In five cases the bandage was applied on the day of the accident. These were one fracture just below the lesser trochanter, one in the middle, and two at the junction of the middle and lower thirds, one being a compound fracture. In seven cases the splint was applied from the second to the fifth day. Of these was one fracture of the neck, one at the junction of the middle and upper thirds, one in the middle, and four at the junction of the middle and lower thirds; one being compound.

In two cases the treatment was not begun until the thirteenth and fifty-ninth days. One phthisical man was tried with the splint from the twelfth till the twenty-third day, but because of decubitus on the perineum the treatment had to be discontinued.

In the cases treated early, consolidation took place in from four to five weeks. A compound fracture, which was converted into a subcutaneous fracture by suture, walked about after the eighth day, and on the twenty-seventh day was consolidated.

In three cases there was no shortening. In only one case was there a shortening of three centimetres; but this was the case of a Pirogoff stump and an oblique fracture at the junction of the middle and lower thirds.

The patients thus treated were able after the first week to walk safely with crutch and cane. Many laid the crutch aside, and some were able finally to walk without any support. Most of the patients after the second week were able to go up and down stairs without assistance.

After the removal of the cast the foot joints were always free. The knee, which at first was somewhat stiff, after a few weeks became perfectly limber.

Atrophy of the quadriceps in most cases was absent entirely, and was only pronounced in compound fractures because of the tearing of the muscle by the end of the upper fragment.

Most of the patients remained for after-treatment till after the third month. One case, an oblique fracture at the junction of the middle and lower thirds of the femur, was able to go to work after the sixth week.

Albers presented before the German Surgical Congress a patient who ten days before had been run over and sustained a compound fracture of the left leg and left thigh. On the fourth day a "gehverband" was applied, and he walked with the aid of a crutch and cane.

V. Krause, in the discussion on the use of the "gehverband" before the last German Surgical Congress, said that he had used the method for seven years. He has worked for three and a half semesters in Altona, and has treated in the ambulant splint the following fractures: Twenty-three fractures of both malleoli, thirteen fractures of the outer malleolus (some with rupture of the internal lateral ligament, and some with the tearing off of the tip of the inner malleolus) with one compound fracture; thirty-six fractures of the leg, of which three were compound, and one was a double fracture of both bones, making in all a total of seventy-two cases of fractures of the bones of the leg. There were also three transverse fractures of the patella, and one compression fracture of the talus.

To this list may be added the following osteotomies and resections which were treated by the same method: one osteotomy for aggravated flat foot; two osteotomies for faulty union in malleolar fractures; eight osteotomies of the femur for genu valgum, once on both sides; one wedge resection for angular ankylosis in the knee; four knee resections for tuberculosis; six ankle resections for tuberculosis; making in all twenty-two operated cases.

The sum of all of the fractures, osteotomies, and resections treated in the "gehverband" is ninety-eight.

He regards it as very important to decide whether quicker consolidation takes place by the ambulant treatment than by the old methods. He presents the following table from Paul Bruns,[1] with which he gives his own results:

AVERAGE PERIOD OF HEALING IN DAYS.

FRACTURES.	TILL CONSOLIDATION.				TILL DISCHARGED FROM HOSPITAL.		
	Gurlt.	Moritz.	Leisrink.	Krause. Gehverband.	Leisrink.	Weber.	Krause. Gehverband.
(1) Leg	56	47	. . .	. . . .	. . .	53	. . . .
(*a*) Upper and middle third	. . .	. . .	70½	41.6	106	. .	60.2
(*b*) Lower third . .	. . .	. . .	47⅓	38.75	80	. .	57·33
(*c*) Both malleoli . .	. . .	. . .	. . .	35·4	. . .	. .	51.
(2) Fibula	42	36	30¾	. . . .	44¼	49	. . . .
Outer malleolus . .	. . .	. . .	. . .	31.3	. . .	. .	47·
(3) Tibia	49	42	51	. . . .	63¼	36	. . . .

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[1] Lehre von den Knochenbrüchen, pp. 268 and 269.

From this table it will be seen that there is much difference in the time of healing in fractures of the fibula. Fractures of both malleoli seem also to heal as quickly under the old methods of treatment as under the new. The fractures of the lower third of the leg heal but slightly quicker in the "gehverband" (38¾ : 47⅓) ; but much more pronounced is the difference in the periods at which the patient is able to go to work without the splint (57⅓ : 80). In the treatment of fractures of the middle and upper thirds of the leg the ambulant method shows a great advantage in the period of consolidation as well as in the time when the patient can return to work. It seems that the higher up the fracture is the sooner a cure is effected by the ambulant method of treatment.

To these statistics may be added the following comments:

The data concerning the period of consolidation can be only relative, for the reason that the cast is not taken off every day for observation of the condition of the fracture. The same is true of the old method. So in no case is the number too small, but more often too high. In order to determine more closely the number of days required for consolidation, Krause made a test case of a laborer, sixty-two years old, whose leg was fractured between the middle and lower thirds by crushing. A compound fracture was present, the wound of which was treated in the usual manner, and progressed aseptically. On the fifth day the plaster cast was applied, and after the seventh day the patient was allowed to walk about. After forty-five days the fracture was not yet united. A new cast was applied, this time with a hinge at the knee-joint. At the end of five weeks a third cast was put on, under which—115 days after the injury—consolidation took place; so that for the first time the patient was able to go about without a splint. The knee was freely movable; the ankle-joint was stiff. Under massage, etc., the full function of the joint was restored 240 days after the accident, and the patient was able to return to work. One year later the old man returned with a fistula, which had developed at the seat of the fracture. After the removal of a small sequestrum, firm healing took place.

Such cases occur with every method of treatment. On the other hand, no other method gives such astonishing results. Another example is that of an old woman, eighty years of age, who sustained a fracture just below the tuberosity of the tibia. For seven days she was treated in extension, and then a walking cast was applied, and on the ninth day after the injury she walked about without pain. Twenty-six days later the cast was removed, and the fracture found to be consolidated. Three days later she was able to walk about without the cast,—thirty-nine days after the injury. On the fiftieth day after the injury she was discharged. She walked with the aid of a cane without pain. The ankle-joint was freely movable; the knee-joint could be flexed to ninety degrees without pain, and still further under slight painfulness.

Krause has tried the experiment upon himself and found that it is not at all unpleasant to go about in a well-fitting walking cast, after a fresh fracture. He sustained a fracture of both malleoli, and had the leg put up in this method. After the sixth day he was able to go about all of his duties without pain. He could climb stairs and walk for hours. After four weeks the fracture was so firmly consolidated that he used no further dressing.

Except in the extremely severe cases he has used the method with good result. The following case is in point: A laborer, forty-five years of age, eight years before suffered amputation of the left thigh in its upper third. He went about usually on crutches, but sometimes with a peg. This patient was crushed between two bumpers, so that the right leg, to an extent of more than six centimetres just below the middle, was comminuted, the muscle bruised, and the skin lacerated. Fortunately the vessels and nerves were not destroyed. It was important to preserve the limb. After five weeks there was still a small granulating wound, but there was not the slightest sign of callus. A plaster cast was applied high up on the thigh without a sitting-ring, and with a fenestrum over the leg. The patient walked on crutches, as his peg was not comfortable. He was able to walk about all day on this greatly injured leg. Consolidation took place under a second dressing in ten weeks. The shortening of the right leg was easily compensated by subjecting the lower end of the peg to an operation by a carpenter.

Krause does not advise the immediate application of fenestrated dressing to all fractures. He does it but exceptionally, and only in very simple cases, in which no marked dislocation is present. After osteotomies or resections the cast can be applied on the first or second day after the operation. The same is done with compound fractures with even and broad surfaces and little tendency to dislocation. For this reason all of the cases reported have healed well, without injury from the walking of the patient. For example, a pronounced double genu valgum, in which Macewen's osteotomy was done on the lower ends of the thigh bones, was put up in the "gehverband," and consolidation had taken place in three and a half weeks after the operation. Both knee-joints were perfectly and freely movable. It is recommended to cut a small window over the wounds in order to keep them perfectly dry.

In all severe fractures he waits some days until the swelling has reached its highest and subsided. During this time extension of twenty or twenty-five pounds is applied in oblique fractures of the leg in which there is a tendency to deformity. In fractures of the malleoli, the extravasations of blood into the joint and under the skin are treated with massage and passive motion.

Krause is of the opinion that the ambulant treatment in plaster splints must be limited principally to fractures and osteotomies in the region of the malleoli, the leg, and the lower end of the thigh. He does not employ the method in the handling of oblique fractures of the femur and fractures of the neck of the same. The mechanical conditions are here much less favorable for the application of the plaster ambulant splint than in the leg. He prefers the ambulant splint of Bruns[1] in these cases. This is put on the third or fifth day. It consists of a well-padded adjustable "sitzring," with two lateral telescopic steel tubes, terminating below in a stirrup. Long, lateral strips of adhesive plaster are fastened into the holes at the sides of the stirrup by means of straps. This splint can then be drawn out to the desired length, and thus as much extension as is required applied. The "sitzring" about the pelvis gives the counter-extension, and the patient can have a lift put under the shoe of the sound side, and be up and about; when the patient lies down the weight can be hooked fast to the stirrup, and thus the pressure of the pelvic ring is relieved. Thus the patient can be treated with extension both while walking about and while lying in bed.

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[1] Bruns: Beiträge zur klinischen Chirurgie, Band x.

It is a matter of interest to observe, in presenting the subject of the plaster "gehverband" to physicians, that those who have had but little experience with plaster in the treatment of fractures and who have confined themselves to the old-fashioned methods, usually fail to grasp the idea of the feasibility and value of this method of treatment, whereas with surgeons experienced in the use of the plaster bandage the practicability of the method is at once appreciated.